Simpson

INSTRUMENTS THAT STAY ACCURATE

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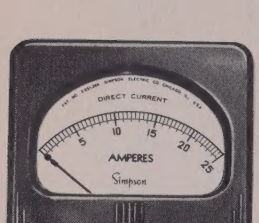
DOCUMENT CONTROL ADMINISTRATOR

OPERATOR'S MANUAL

VARIDOT WHITE DOT GENERATOR
MODEL 434A

SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44, Illinois, ES 9-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

PANEL METERS by Simpson



MODELS 27, 37, 47, 57
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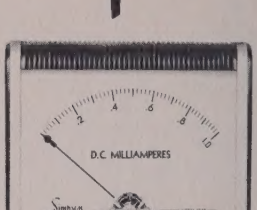
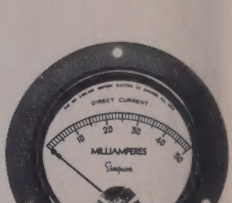
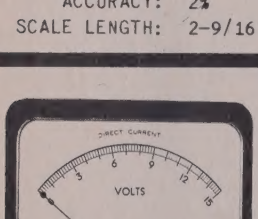
ACCURACY: 2%
SCALE LENGTH: 2-9/16"



SIMPSON MODERNISTIC "CLEAR-VUE"
BUILT TO SPECIAL ORDER
2½", 3½", 4½", 5½" SIZES



MODELS 25, 35, 45, 55
3½" ROUND, ACCURACY 2%
SCALE LENGTH: 1-7/8"
ALSO AS **MODELS 125, 135 145 AND 155** – ALL 2½" ROUND. SCALE 1-7/8"



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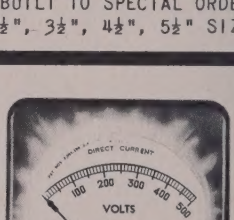
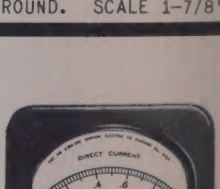


MODELS 27, 37, 57
ILLUMINATED
3½" RECTANGULAR
ACCURACY: 2%
SCALE LENGTH: 1-5/16"



MODELS 127, 137, 147, 157,
2½" RECTANGULAR
ACCURACY: 2%
SCALE LENGTH: 1-7/8"

NEARLY 800 DIFFERENT SIZES AND KINDS OF SIMPSON PANEL METERS ARE AVAILABLE FROM YOUR ELECTRONIC PARTS JOBBER. WHETHER YOU NEED ONE PANEL METER ..... OR A DOZEN ..... LOOK FOR THE FAMILIAR ORANGE COLORED SIMPSON BOX. FOR FURTHER INFORMATION WRITE SIMPSON ELECTRIC CO., 5200 W. KINZIE ST., CHICAGO 44, ILL., ESTEBROOK 9-1121.

OPERATOR'S MANUAL

SIMPSON
VARIDOT
WHITE DOT GENERATOR
MODEL 434A

SIMPSON ELECTRIC COMPANY

5200 W. Kinzie St., Chicago 44, Illinois, EStebrook 9-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

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FIG. 1 ILLUSTRATION OF SIMPSON VARIDOT WHITE DOT GENERATOR MODEL 434A.

SECTION I

GENERAL DESCRIPTION

VARIDOT HAS FOUR USES . . .

The SIMPSON VARIDOT WHITE DOT GENERATOR Model 434A is an instrument designed to provide white dots for use in the adjustment of convergence of color television receivers and for the checking of many properties of both color and black and white television receivers such as:

1. Linearity of sweeps
2. Receiver frequency response
3. Hum in picture when receiving programs
4. Operation of receiver synchronizing circuits

. . . AND 12 IMPORTANT FEATURES!

The features of the SIMPSON VARIDOT WHITE DOT GENERATOR Model 434A include the following:

1. Ninety percent modulation for clear bright dots
2. Very narrow dots obtainable – approximately one line high and comparable width.
3. Both horizontal and vertical retraces blanked out
4. R.F. output and both polarities of video output
5. Independent dot width and dot height controls
6. Independent horizontal dot number and vertical dot number controls
7. Vernier control of vertical synchronizing frequency to allow check of receiver both at line frequency and off line frequency (as on network programs)

8. High stability of dots
9. R.F. output in all television channels 2 through 6
10. Balanced 300 ohm R.F. output
11. Unbalanced 300 ohm R.F. output
12. Weight only 11¾ lbs. for convenient portability

SPECIFICATIONS AND TUBE COMPLEMENT

1. Power Source – 115 volts, 60 cps, 50 watts
2. R.F. Frequency Range – 55.25 M.C. to 83.25 M.C. (Picture carriers channels 2 – 6)
3. R.F. Output – Variable up to 50,000 microvolts R.M.S. open circuit
4. Video Output – Variable up to 3.5 volts peak-to-peak open circuit
5. Output Impedance – 300 ohms balanced for R.F. and unbalanced for video
6. Dot Width (video output)–variable from 0.2 microseconds to 1.8 microseconds at points 20% from pulse base
7. Dot Height (video output)–variable from one to eight lines high
8. Vertical Dot Number – Variable from 6 – 12
9. Horizontal Dot Number – Variable from 6 – 11
10. Weight – 11¾ lbs
11. Output Cable – supplied with plug and clip leads for both video and R.F. – 5 feet long
12. Tube Complement – 2 ea. 12AU7, 1 ea. 12AT7, 4 ea. 6AN8, 1 ea. 5Y3

8 FRONT PANEL CONTROLS PROVIDE BASIS FOR EASE OF OPERATION

1. FRONT PANEL

   Attenuator (for both R.F. and video)
   Tuning control (channels 2 through 6)
   Function Selector (Off, Video +, Video –, R.F.)
   Hum Check (Horizontal synchronizing frequency vernier)
   Horizontal Dot Number
   Dot Width
   Vertical Dot Number
   Dot Height

2. INSIDE OF CASE CONTROLS

   Horizontal frequency, 12:1 frequency, divider, coarse and fine vertical frequency adjustments. The fine vertical frequency control also accessible through a hole provided in the case.

SECTION II

OPERATION

HOW TO USE WITH R.F. INPUT TO TELEVISION RECEIVER

1. Plug in line cord (115 V., 60 cps source) and turn function switch from "OFF" position to "RF". Dial light should glow.
2. Plug output cable into R.F. receptacle in back of case.

3. Disconnect antenna from television receiver and connect the 434A output cable to receiver antenna terminals.
4. Tune the receiver to a low band channel (2 through 6) that is vacant in the particular locality.

CAUTION

Many television receivers having turret tuners are not lined up properly for channels not in use in the particular locality in which the receiver is used. In such cases one of the vacant channels should be aligned using a suitable generator as a signal source such as the Simpson Model 479 or 480. The reception of even a small signal from a station simultaneously with a signal from the SIMPSON VARIDOT WHITE DOT GENERATOR Model 434A will cause "jitter" or instability of the synchronization of the receiver.

5. Set the hum check control at mid range and all other front panel controls maximum clockwise.
6. Tune the "Channels" control of the Varidot Generator to the frequency to which the receiver is tuned. The VARIDOT WHITE DOT GENERATOR provides both upper and lower side bands. A good picture will usually result with the carrier on either skirt of the receiver pass band.

   With proper tuning the carrier frequency of the SIMPSON VARIDOT WHITE DOT GENERATOR should be close enough to the low side of the receiver pass band that the dots can be made very

small. The dots should not be so close to the low side that the vertical synchronizing pulses cease to be received properly.

7. Adjust the "Hum Check" control until the picture stands still. With television receivers having very little hum in their pictures this control can be moved over a wide range with little effect on the picture.

   The hum check control is actually a fine Horizontal synchronizing frequency adjustment, and by synchronization also a vernier control of the vertical synchronizing frequency. It can pull the vertical frequency 60 ± .6 cps.

   To detect hum this control is varied to change the vertical frequency so that it differs from the power line frequency. Any slight hum is easily detected by the appearance of vertical weaving in the dot pattern.

8. Adjust the "Attenuator" control until the best picture results. With receivers having A.G.C. this adjustment will not be critical unless there is an interfering signal to be overridden in which case the maximum signal (full clockwise position of the control) will probably give best results.

9. After the above adjustments have been made it should be possible to set the "Dot Width", "Dot Height", "Horizontal Dot Number", and "Vertical Dot Number" controls anywhere in their ranges in any combination with stable patterns resulting.

SMALL DOTS REQUIRED FOR CHECKING VIDEO INPUT TO TELEVISION RECEIVER

If extremely fine dots of the order of one line width are desired best results will usually be obtained by feeding directly into the receiver video circuits since the bandwidth limitations of the R.F. circuitry are thereby avoided.

1. Connections and adjustments of the SIMPSON VARIDOT WHITE DOT GENERATOR are the same as when used with R.F. input to the receiver with the following exceptions:

   (a) Plug output cable into "Video" receptacle on back of case.

   (b) Connect black clip lead of cable to chassis of receiver and red clip lead in series with a .1 mf condenser to the video input of the receiver at a point requiring a video signal of four volts or less.

   (c) Set "Function" control to "video +" or "video –" position as required for the particular polarity of signal normally existing in the receiver at the point to which the SIMPSON VARIDOT WHITE DOT GENERATOR Model 434A is connected. In the "video +" position the synchronizing pulses are positive and the dot pulses are negative. In the "video –" position the reverse is true.

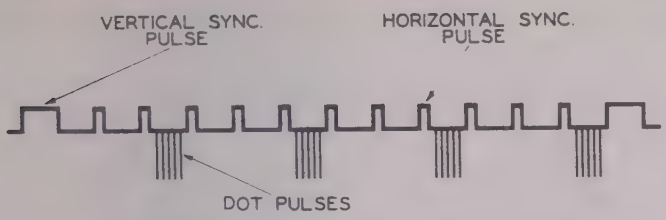


FIG. 2 SIMPLIFIED VIDEO OUTPUT WAVEFORM

SECTION III

CIRCUIT DESCRIPTION AND THEORY OF OPERATION

VIDEO WAVEFORM . . . 525 HORIZONTAL SYNCHRONIZING PULSES

A simplified drawing of the video output waveform of the VARIDOT WHITE DOT GENERATOR is shown in Fig. 2. The waveform of Fig. 2 shows only eleven horizontal synchronizing pulses in a vertical field whereas there are actually 525 of them. In operation the first vertical synchronizing pulse would start the vertical sweep in the television receiver. The receiver would then sweep through several horizontal lines initiated by several horizontal synchronizing pulses (indicated by the first Horizontal sync. pulse of Fig. 2).

During the next horizontal sweep period several dot pulses would be received (five shown in Fig. 2). The receiver would then sweep through several more

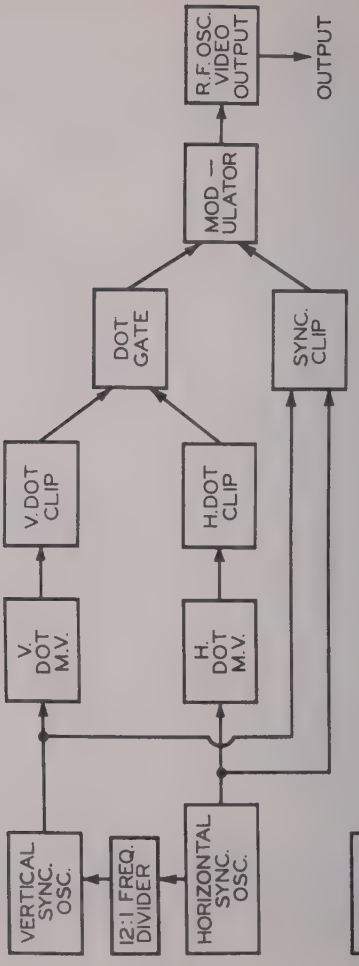


FIG. 3 FUNCTION DIAGRAM

horizontal lines, the number determining the vertical distance between dots (two synchronizing pulses shown in Fig. 2) then the next row of dots would be received. The video waveform of Fig. 2 would correspond to a pattern consisting of four horizontal rows of dots counting from top to bottom of the picture and five vertical rows of dots counting from left to right of the picture.

FUNCTION DIAGRAM EXPLAINED

A block functional diagram of the VARIDOT WHITE GENERATOR Model 434A is shown in Fig. 3. Two free running multivibrators, a vertical synchronizing blocking oscillator, a 12:1 frequency divider and a horizontal synchronizing oscillator.

The vertical synchronizing oscillator is synchronized with the 12:1 frequency divider which in turn is synchronized with the horizontal synchronizing oscillator. Two free running multivibrators, the Vertical Dot multivibrator and the Horizontal Dot Multivibrator, are synchronized with the vertical and horizontal sync. oscillators respectively.

The signals from these two multivibrators are differentiated and the resulting pulses are fed into two clippers, the Vertical Dot Clipper and the Horizontal Dot Clipper respectively.

The pulses from these clippers are then applied to the Dot Gate such that the horizontal dot pulses are passed through the gate only during the intervals

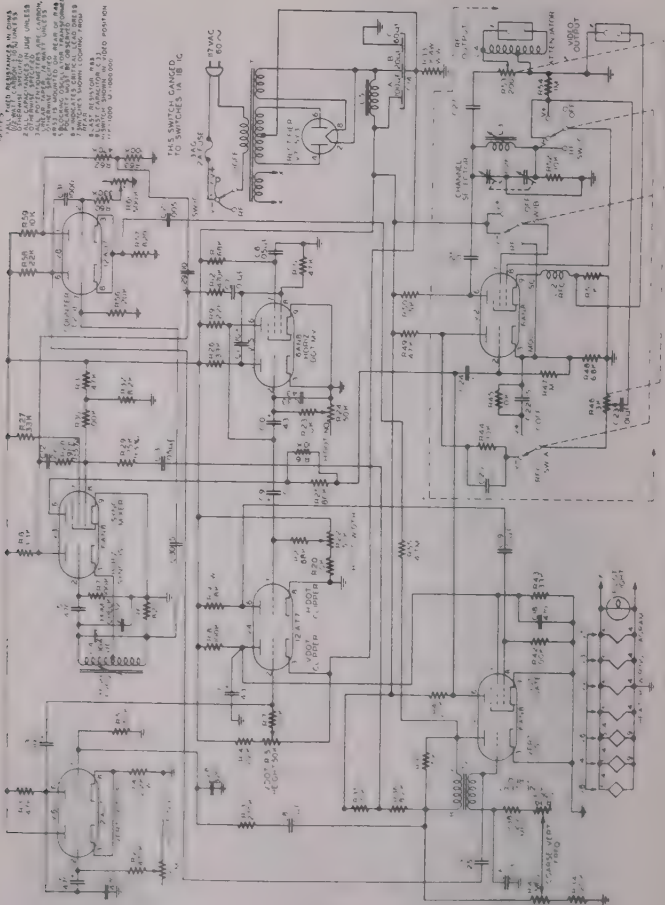


FIG. 4 CIRCUIT SCHEMATIC DIAGRAM

when the vertical pulses are applied to the gate. These gated pulses are then applied to the input of the Modulator.

Pulses from the Vertical Sync. Oscillator and Horizontal Sync. Oscillator are shaped and added in the Sync. Clipper and are also applied to the Modulator. The composite output of the modulator is applied to the R.F. Oscillator modulating it when the "Function" switch is in the R.F. position. When this switch is in one of the "Video" positions the modulator acts as a phase splitter providing either polarity of video signal which can be applied to the R.F. oscillator tube which is switched so that it no longer oscillates but acts as a cathode-follower video output tube.

CIRCUIT DIAGRAM (FIGURE 4) EXPLAINED

HORIZONTAL SYNC. OSCILLATOR

The Horizontal Sync. Oscillator uses the triode section of a 6AN8 tube in a Hartley circuit. The frequency of oscillation is determined by C4, C32, and L1, L1 being a slug tuned coil inside the case. The voltage developed across R6, between the tank circuit (C4 and L1) and ground is coupled through C5 to the grid of the 12:1 frequency divider and provides a synchronizing signal to this divider. The voltage developed across the plate load resistor, R8, is coupled to the grid of the Sync. Mixer through C12 and R28, to the Horizontal Dot Multivibrator through R12

and C7 (to provide the keying signal to this multivibrator) and also through C29 to R63 (to provide a test point for adjusting the 12:1 divider).

VERTICAL SYNC. OSCILLATOR

The Vertical Sync. Oscillator uses the triode section of a 6AN8 as a blocking oscillator. Its frequency is controlled by R40 (coarse vert freq), located inside the case, and R39 (fine vert freq), which is also located inside the case but is accessible through a hole provided in the case. R39, R40 are adjusted for 60 cps.

The voltage developed across R36 and R35 is applied to the Vertical Dot Multivibrator through C8 and R13, and provides the keying signal to this multivibrator. The voltage across the R35 is applied through C13 and R29 to the Sync. Mixer, where it is mixed with the horizontal sync signal. The voltage developed at the plate, Pin 1, is coupled through R55 and C21 to R57 (to provide a test point for adjusting vertical frequency).

FREQUENCY DIVIDER (12:1)

The frequency divider uses both sections of a 12AU7 in a conventional multivibrator circuit. The frequency is controlled by R61 located inside the case. The voltage developed across R58 is coupled through C15 to the grid of the vertical sync. oscillator, and provides a synchronizing signal to this oscillator. The voltage developed across R59 is

coupled through R62 to R63 (to provide a test point for adjusting the 12:1 divider).

HORIZONTAL DOT MULTIVIBRATOR AND HORIZONTAL DOT CLIPPER

The Horizontal Dot Multivibrator uses both sections of a 6AN8 tube. Its frequency is controlled by R24 (horizontal dot no.) on the front panel. Since the multivibrator is keyed from the Horizontal Sync Oscillator, its frequency is a multiple of the Horizontal Oscillator frequency.

The waveform at the plate, pin 6, of this tube is differentiated by C9 and R21. The negative pulse obtained in this way is applied to the grid, pin 7, of the Horizontal Dot Clipper. This pulse, after inversion and amplification by the Horizontal Dot Clipper, is applied to the control grid, pin 8, of the Dot Gate.

A positive bias is applied to the grid of the Clipper through R21 and is controlled by R22 (horizontal dot width) which is a part of a voltage divider between B+ and ground.

The time during which the negative pulse applied to the grid exceeds in amplitude the positive bias determines the width of the positive pulse applied to the control grid of the Dot Gate.

VERTICAL DOT MULTIVIBRATOR AND VERTICAL DOT CLIPPER

The Vertical Dot Multivibrator uses both sections

of a 12AU7. Its frequency is controlled by R1 (vertical dot no.) on the front panel. Since the multivibrator is keyed by a 60 cps. signal from the Vertical Sync. Oscillator, its frequency is a multiple of 60 cps.

The operation of this circuit is similar to the Horizontal Dot Multivibrator and Horizontal Dot Clipper described above; the only difference being that the positive pulse from the Clipper is applied to the screen grid of the Dot Gate instead of the control grid. It will be helpful in understanding the operation of the Dot Gate to note that the Vertical Dot Clipper is operated at potentials below ground, since its cathode is returned directly to B–. Ground is more positive than B– due to the voltage developed across R33.

DOT GATE

The Dot Gate is the pentode section of a 6AN8. The voltage on the screen, pin 7, is negative with respect to the cathode except when a positive pulse appears at the plate of the Vertical Dot Clipper. Therefore, the Dot Gate can amplify only for the duration of these positive pulses. Also, before the tube can amplify, a positive pulse from the Horizontal Dot Clipper must appear on the control grid simultaneously with the pulse on the screen grid.

The voltage developed across R42 due to slight grid current is enough to bias the tube sufficiently to prevent amplification. Thus a decrease in amplitude

of the output pulse from either clipper would result in decreased composite output of the Dot Gate.

SYNC. MIXER

The Sync. Mixer is the pentode section of a 6AN8. The signals from both the Vertical and Horizontal Sync. Oscillators are coupled to the control grid, pin 8, and are combined and amplified by this tube.

The Sync. Mixer and the Dot Gate have a common plate load, R41, so that the waveform appearing across R41 consists of both the negative dot pulses and the positive sync. pulses. The voltage across R41 is coupled through C24 to the grid, pin 2, of the modulator.

MODULATOR – OSCILLATOR

The Modulator is the triode section of a 6AN8, and the Oscillator is the pentode section of the same 6AN8. When the "Function" switch is in the "R.F." position, the modulator triode acts as a cathode follower and the video signal on its cathode, pin 3, is applied to the screen grid, pin 7, of the Oscillator.

The Oscillator frequency is determined by the tank circuit consisting of C26 and L3, and covers the frequency range from Channel 2 to 6. The amplitude of the R.F. signal at the RF output terminal is controlled by R53 (Attenuator).

When the "Function" switch is in either the "Video +" or "Video –" position, the Modulator acts as a phase inverter with the minus polarity on

the plate, pin 1, and the plus polarity on the cathode, pin 3. The signal from the Modulator, controlled by R46 (ganged with R53, Attenuator), is then fed to the control grid, pin 8, of the Oscillator, which now is a cathode follower with the video output from its cathode applied to the video output terminal.

SECTION IV

MAINTENANCE

A. TROUBLESHOOTING

Since the circuitry design is straight forward and parts non critical, conventional techniques are sufficient (scope for stage by stage waveform analysis with subsequent voltage and resistance measurements) to locate and correct any troubles encountered.

B. INTERNAL ADJUSTMENTS

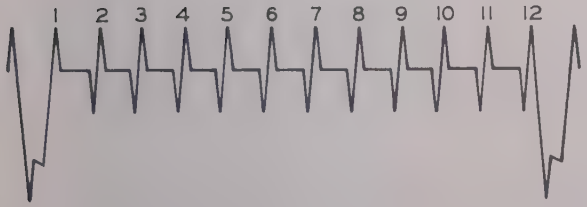
With aging of components and changing of tubes it may be necessary to make internal adjustments.

The procedure is as follows:

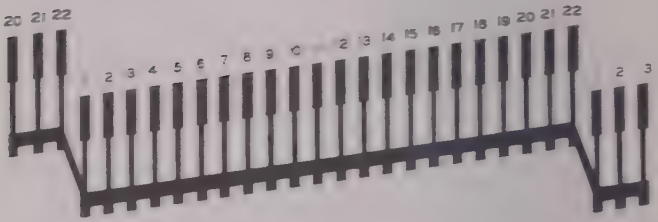
1. Remove chassis from the case (4 screws on the rear of the case)
2. Set hum check at range center and all other front panel controls maximum clockwise.
3. Using a Simpson 458 colorscope or equivalent connect the vertical input across R6.
4. Connect the 15,840 cps output of an audio oscillator to the horizontal input of the scope (scope on external sweep).

5. Adjust L1 to obtain a 1:1 frequency Lissajous pattern.

6. Return scope to internal sweep and connect the vertical input of the scope across R63.
7. Adjust R61 for 12:1 countdown pattern. (R61 set in center of pull in range)



8. Connect the vertical input of the scope from the R55, C21 junction to ground.
9. Set R39 to its midpoint and adjust R40 for a 22:1 countdown pattern.



10. Vary R39, and note low and high resistance limits for a 22:1 countdown. Set R39, 2/3 up from the low resistance limit. Increasing resistance is clockwise rotation.
11. Set scope on external sweep and connect the 60 cps output of an audio oscillator to the horizontal input of the scope.
12. Adjust L1 so the pattern from step 9 nearly stands still. If a major change in L1 is necessary repeat steps 6 through 9.

NOTE

The internal control most likely to need adjustment will be R39 and it can be readjusted through a hole provided on the right hand side of the case.

PARTS LIST

C1	Capacitor 470 MMF 500V ±10% ceramic	1-113978
C2	Capacitor 470 MMF 500V ±10% ceramic	1-113978
C3	Capacitor 1000 MMF +20, −10% 500V ceramic	1-115462
C4	Capacitor .004 MF ±10% 500V ceramic	1-115481
C5	Capacitor 470 MMF 500V ±10% ceramic	1-113978
C6	Capacitor .05 MF 200V ±20%	1-115774
C7	Capacitor .01 MF +20, −10% 200V paper	1-115461
C8	Capacitor .1 MF +20, −10% 200 V paper	1-114400
C9	Capacitor 10 MMF 500V ±10% ceramic	1-115465
C10	Capacitor 43 MMF 500V ±10% ceramic	1-115482
C11	Capacitor 10 MMF 500V ±10% ceramic	1-115465
C12	Capacitor 220 MMF 500V ±10% ceramic	1-113854
C13	Capacitor .05 MF 200V ±20%	1-115774
C14	Capacitor, Electrolytic, 3 section 100/60/20 MF 300/250/250 WV	1-115475
C15	Capacitor 25 MMF 500V ±10% silver mica	1-114689
C16	Capacitor, .03 MF 200V ±10%	1-115773
C17	Capacitor 43 MMF 500V ±10% ceramic	1-115482
C18	Capacitor 470 MMF 500V ±10% ceramic	1-113978
C19	Capacitor .01 MF +20, −10% 200V paper	1-115461
C20	Capacitor 10 MMF 500V ±10% ceramic	1-115465
C21	Capacitor .005 MF 350V ceramic	1-115248
C22	Capacitor 15 MMF 500V ±10% ceramic	1-115464
C23	Capacitor .01 MF +20, −10% 200V paper	1-115461
C24	Capacitor .1 MF +20, −10% 200V paper	1-114400
C25	Capacitor 10 MMF 500V ±10% ceramic	1-115465
C26	Tuning capacitor, 5 to 27.5 MMF	1-115456
C27	Capacitor 1 MMF 500V ±10% ceramic	1-115579
C28	Capacitor 820 MMF 600V ceramic	1-116220
C29	Capacitor 10 MMF 500V ±10% ceramic	1-115465
C30	Capacitor .001 MF 350V silver mica	1-116226
C31	Capacitor 5 MMF 600V ceramic	1-116227
C32	Tuning capacitor, 13.8 to 374.2 MMF	1-116224

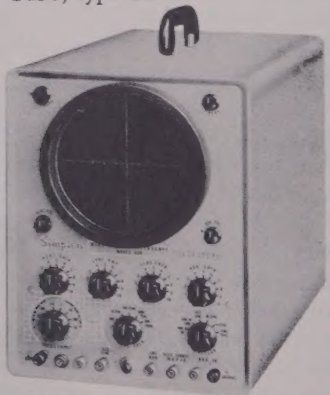
PARTS LIST

C33	Capacitor 43 MMF 500V ±10% ceramic	1-115482
F1	Fuse, Slow-blowing, 0.6 amp @ 250 volts	1-115995
L1	Coil Assembly, Horiz. oscillator	1-115470
L2	Choke, R.F.	1-115468
L3	Coil Assembly, R.F. oscillator, .75 microhenry, slug tuned	1-115471
L4	Coil Assembly, Antenna Balancing, .39 microhenry	1-115469
L5	Choke, Filter	1-115455
R1	Potentiometer, 1 megohm, 20%	1-115473
R2	Resistor 470,000 ohms 10% ½ w carbon	1-114227
R3	Resistor 47,000 ohm 10% ½ w	1-114881
R4	Resistor 2,200 ohms 10% 1 w	1-113930
R5	Resistor 150,000 ohms 10% ½ w	1-113677
R6	Resistor 820 ohms 10% ½ w	1-112621
R7	Resistor 100,000 ohms 10% ½ w	1-113949
R8	Resistor 3,300 ohms 10% ½ w	1-114225
R9	Resistor 22,000 ohms 10% ½ w	1-113439
R10	Resistor 47,000 ohms 10% ½ w	1-114881
R11	Resistor 68,000 ohms 10% ½ w	1-114803
R12	Resistor 470,000 ohms 10% ½ w	1-114227
R13	Resistor 270,000 ohms 10% ½ w	1-115497
R14	Resistor 22,000 ohms 10% ½ w	1-113439
R15	Potentiometer 50,000 ohms 10%	1-115997
R16	Resistor 1,200 ohms 10% ½ w	1-114680
R17	Resistor 100,000 ohms 10% ½ w	1-113949
R18	Resistor 100,000 ohms 10% ½ w	1-113949
R19	Resistor 1,800 ohms 10% 1 w	1-115771
R20	Resistor 10,000 ohms 10% ½ w	1-111671
R21	Resistor 68,000 ohms 10% ½ w	1-114803
R22	Potentiometer 50,000 ohms 10%	1-115997
R23	Resistor 10,000 ohms 10% ½ w	1-111671
R24	Potentiometer 50,000 ohms 10%	1-115997
R25	Resistor 68,000 ohms 10% ½ w	1-114803

PARTS LIST

R26	Resistor 33,000 ohms 10% ½ w	1-113945
R27	Resistor 33,000 ohms 10% ½ w	1-113945
R28	Resistor 91,000 ohms 5% ½ w	1-115327
R29	Resistor 75,000 ohms 5% ½ w	1-111978
R30	Resistor 100,000 ohms 10% ½ w	1-113949
R31	Resistor 47,000 ohms 10% ½ w	1-114881
R32	Resistor 8,200 ohms 10% ½ w	1-113050
R33	Resistor 1,000 ohms 10% 4 w	1-115772
R34	Resistor 120,000 ohms 10% ½ w	1-113044
R35	Resistor 10,000 ohms 10% ½ w	1-111671
R36	Resistor 8,200 ohms 10% ½ w	1-113050
R37	Resistor 15,000 ohms 10% ½ w	1-111678
R38	Resistor 2.2 megohms 10% ½ w	1-114683
R39	Potentiometer 250K 20%	1-116219
R40	Potentiometer 1 megohm 20%	1-115473
R41	Resistor 2,700 ohms 10% ½ w	1-113942
R42	Resistor 100,000 ohms 10% ½ w	1-113949
R43	Resistor 33,000 ohms 10% ½ w	1-113945
R44	Resistor 10,000 ohms 10% ½ w	1-111671
R45	Resistor 10,000 ohms 10% ½ w	1-111671
R46	Potentiometer, Dual, front section 3000 ohms ½ w; rear section 200 ohms 20% ½ w	1-115996
R47	Resistor 1 megohm 10% ½ w	1-113952
R48	Resistor 6,800 ohms 10% ½ w	1-113048
R49	Resistor 4,700 ohms 10% ½ w	1-114058
R50	Resistor 1,500 ohms 10% ½ w	1-114681
R51	Resistor 1,000 ohms 10% ½ w	1-111689
R52	Resistor 10,000 ohms 10% ½ w	1-111671
R53	Potentiometer, Dual. Front section 3000 ohms ½ w; rear section 200 ohms 20% ½ w	1-115996
R54	Resistor 1 megohm 10% ½ w	1-113952
R55	Resistor 4.7 megohms 10% ½ w	1-115494
R56	Resistor 270,000 ohms 10% ½ w	1-115497
R57	Resistor 820 ohms 10% ½ w	1-112621

R58	Resistor 22,000 ohms 10% ½ w	1-113439
R59	Resistor 10,000 ohms 10% ½ w	1-111671
R60	Resistor 270,000 ohms 10% ½ w	1-115497
R61	Potentiometer 500K	1-114707
R62	Resistor 470,000 ohms 10% ½ w	1-114227
R63	Resistor 100,000 ohms 10% ½ w	1-113949
R64	Resistor 10,000 ohms 10% ½ w	1-111671
SW1	Switch, 2 deck, 4 position	1-116221
T1	Transformer, power	1-115454
T2	Transformer, Blocking Oscillator	1-115453
V1	Tube, type 6AN8	1-115373
V2	Tube, type 6AN8	1-115373
V3	Tube, type 6AN8	1-115373
V4	Tube, type 12AT7	1-115466
V5	Tube, type 6AN8	1-115373
V6	Tube, type 12AU7	1-114083
V7	Tube, type 5Y3	1-114671
V8	Tube, type 12AU7	1-114083



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This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service stations, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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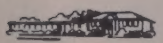

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